In the wake of significant geopolitical shifts, **TQM Hedge Fund**, a leading entity specializing in **macro strategies**, finds itself navigating through a landscape fraught with **increasing political and trade tensions**. The recent policies enacted by the **new US administration**, particularly the imposition of **tariffs on key imports**, have set off a chain reaction of **retaliatory measures** from major trading partners. These developments have profound **macroeconomic implications**, including disrupted supply chains, fluctuating currency values, and heightened market volatility.

The escalation in trade conflicts has not only affected bilateral trade relationships but has also introduced **systemic risks** that permeate global financial markets. Industries reliant on international trade face uncertainties that can lead to **reduced corporate earnings**, **stock market downturns**, and **increased inflationary pressures**. For a hedge fund like TQM, which manages portfolios sensitive to global economic indicators, these macroeconomic disturbances necessitate a **robust hedging strategy** to safeguard assets and maintain portfolio performance.

Recognizing the potential **adverse impacts** of these trade tensions on its diversified portfolios, TQM's chief portfolio manager has sought the expertise of a consulting firm to devise an **optimal hedging policy**. The objective is to mitigate the **current and foreseeable risks** stemming from geopolitical instability and to ensure that the fund's portfolios remain resilient in the face of ongoing economic uncertainties.

TQM oversees four distinct portfolios, each aligned with specific global indices to capture diverse market segments. Below is an overview of each portfolio:

- **Portfolio 1: MSCI World Index Replication**
    - **Current Value**: $500,000,000
    - **Description**: Comprising a diversified set of global equities, this portfolio mirrors the performance of the **MSCI World Index**, offering broad exposure to developed markets across North America, Europe, Asia, and Australia.
- **Portfolio 2: MSCI Emerging Markets Index Replication**
    - **Current Value**: $200,000,000
    - **Description**: Focused on high-growth regions, this portfolio seeks to replicate the **MSCI Emerging Markets Index**, encompassing stocks from developing economies with significant expansion potential in Asia, Latin America, Africa, and the Middle East.
- **Portfolio 3: MSCI Europe Index Replication**

  - **Current Value**: $175,000,000
  - **Description**: Concentrated on European equities, this portfolio tracks the **MSCI Europe Index**, providing exposure to companies across various European countries, including those directly impacted by trade policies between the US and Europe.

- **Portfolio 4: MSCI Pacific Index Replication**
  - **Current Value**: $160,000,000
  - **Description**: Targeting the Asia-Pacific region, this portfolio mirrors the **MSCI Pacific Index**, including major economies like Japan, Australia, South Korea, and others in the Pacific Rim, which are at the forefront of retaliatory trade measures.

Amidst the backdrop of **rising tariffs** and **retaliatory trade measures**, the chief portfolio manager of TQM is concerned about the potential **market volatility** and its adverse effects on the fund's portfolios. The primary objective of engaging the consulting firm is to:

- **Assess Current Risk Exposure**: Understand how geopolitical tensions are influencing the performance and risk profiles of each portfolio.
- **Develop an Effective Hedging Strategy**: Implement hedging mechanisms that can protect portfolio values against anticipated market downturns and volatility resulting from trade conflicts.
- **Optimize Hedge Efficiency**: Ensure that the hedging policies balance risk mitigation with cost-effectiveness, avoiding over-hedging that could erode potential returns.

To achieve the hedging objectives, the consulting firm has identified the use of **futures contracts** on major indices that correlate with TQM's portfolios. The available futures instruments and their specifications are as follows:

Futures Contract	Underlying Index	Contract Size	Current Futures Value
CME-MINI S&P 500 INDEX	S&P 500 Index	50	4,500
CME-E MINI FTSE EMER INDEX	FTSE Emerging Markets Index	100	1,200
CME-EMINI FTSE CHINA 50 INDEX	FTSE China 50 Index	2	3,800
CME-NIKKEI 225 INDEX	Nikkei 225 Index	5	22,000

Use the following analyses to provide a recommendation about the best hedging policy for the company.

A. The first type of policy would be to hedge the portfolios individually. The bank is exploring combinations of the following contracts: e-mini S&P 500 futures, Nikkei 225 USD futures, e-mini FTSE emerging index futures, and e-mini FTSE China 50 Index Futures.
   a) For each portfolio, compute the correlation between its returns and those of each futures. Employ one-week returns in your calculations. To compute portfolio returns, use the time-series of the indexes provided in the file "Hedging_PortfolioValue_21.xls" (spread sheet "Indexes"). For instance, the weekly returns of Portfolio 1 should be computed from the MSCI global index prices. For futures returns, their historical prices are in the same file (spread sheet "Futures" contains weekly observations for the continuous contract). In addition, estimate the volatility of each portfolio and the correlation matrix between the portfolios' returns. Estimate the overall portfolio's volatility using the correlation matrix, the individual portfolio volatilities, and the relative weights of each portfolio (annualize the overall portfolio's volatility by multiplying the weakly estimate by sqrt(52)).
   b) Use the following regression model to determine the optimal hedging ratio:

$$I_t = \alpha + \beta F_t + \varepsilon_t.$$

   In the above equation, **I** is the one-week return of a given portfolio, **F** is the one-week return of the e-mini S&P 500 futures contract, and the last term is the error term in the regression. How many contracts are required to hedge each portfolio? Provide a table in which you give the parameters of each regression (intercept, slope, R^2, t-stat for the slope parameter).